WELLAND SHIP CANAL

General Information
and
Description of Work

1916

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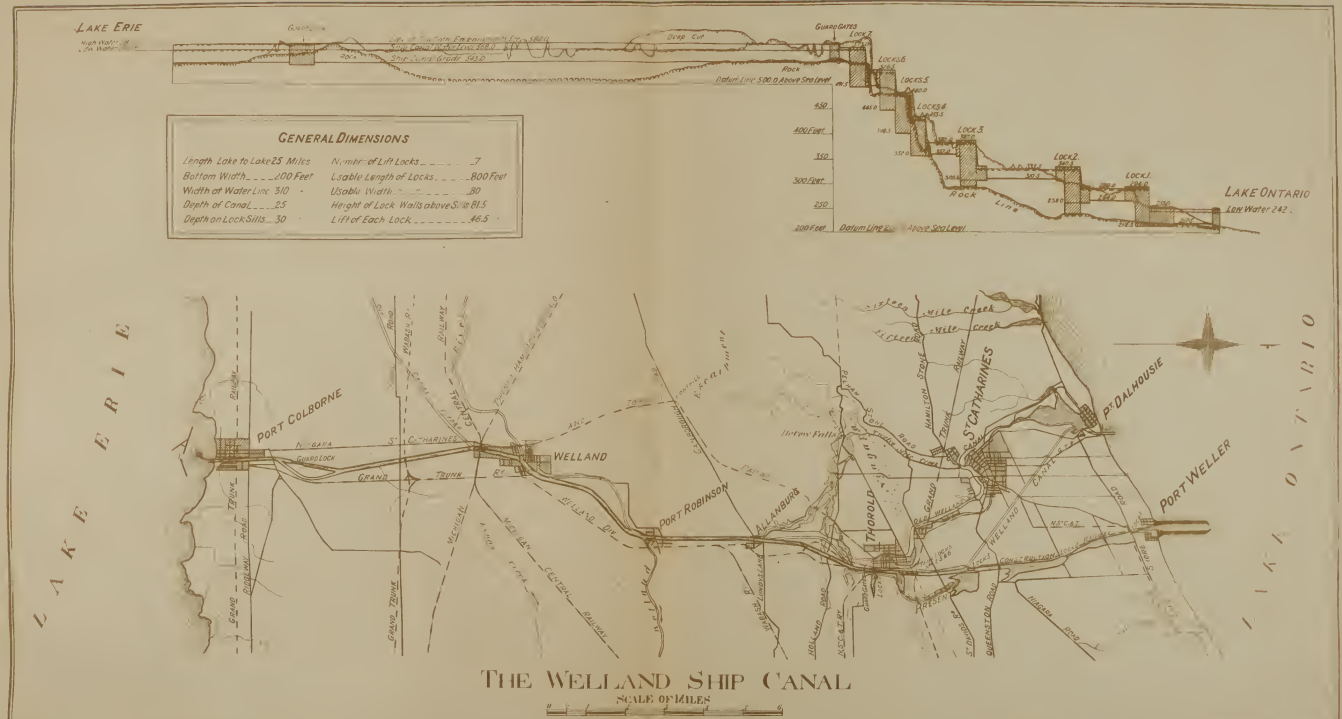
September 25th, 1916


LAKE ERIE
Guard Gates
Deep Cut
Guard Gates
Lock 7
Locks 6
Locks 5
Locks 4
Locks 3
Lock 2
Lock 1
Rock
Datum Line 500.0 Above Sea Level
450
400 Feet
350
300 Feet
250
200 Feet
Datum Line 2 Above Sea Level
LAKE ONTARIO
Lake Water 242
GENERAL DIMENSIONS
Length Lake to Lake 25 Miles
Bottom Width 200 Feet
Width at Water Line 310
Depth of Canal 25
Depth on Lock Sills 30
Number of Lift Locks 7
Usable Length of Locks 800 Feet
Usable Width 80
Height of Lock Walls above Sea 81.5
Lift of Each Lock 46.5
LAKE ERIE
LAKE ONTARIO
PORT COLBORNE
WELLAND
PORT ROBINSON
ALLANBURG
THOROLD
ST. CATHARINES
PT. DALHOUSIE
PORT WELLER
Welland River
Welland Canal
Grand Trunk
Niagara
Guard Lock
Welland Div.
Merritt Creek
Central Railway
Mc Cat
Lake Shore Rd.
Dalhousie Road
Hamilton Road
Burleston Road
Hagar Road
Mile Creek
Twelve Mile Creek
Fifteen Mile Creek
Lake Shore Rd.
Welland Ship Canal
Scale of Miles

General Information

The distance from Lake Erie to Lake Ontario by way of the Welland Ship Canal is 25 miles.

Lake Erie is 326 ft. higher than Lake Ontario, and this difference in level will be overcome by seven lift locks, each lock raising or lowering a vessel 46½ ft.

The Present Canal has 25 lift locks of only 12 to 14 ft. lift.

The dimensions of the locks of the Welland Ship Canal will be: 800 ft. long in the clear, 80 ft. wide, and 30 ft. depth of water.

The locks on the Present Canal are: 270 ft. long, 45 ft. wide, and 14 ft. depth of water.

Locks Nos. 1, 2, 3 and 7 will be single locks, while locks Nos. 4, 5 and 6, ascending the escarpment at Thorold, will be double locks in flight, that is, each pair rising one above the other.

The dimensions of the Canal between locks, and on the long level between Thorold and Lake Erie, will be: 200 ft. wide at the bottom, 310 ft. wide at the water line, and 25 ft. depth of water.

The largest vessel sailing the Lakes today is 625 ft. long, with 59 ft. beam, and as navigation of the channels connecting the Upper Lakes does not at present permit of a greater draught than 20 ft., it is considered that the capacity of the Welland Ship Canal, when completed, will be ample for a great many years to come.

When greater depth is required, it can be obtained by dredging out the Canal to 30 ft. in depth, as the locks and other structures are now being built to afford that depth of water.

Total quantity of earth to be excavated: 40,000,000 cubic yards; of rock 6,000,000 cubic yards.

If all this material were loaded on dump cars, of the kind which may be seen passing along the Construction Railway parallel with the Canal, it would require a train of such cars 15,000 miles long, extending half way around the globe, to hold it.

Total quantity of concrete to be placed: 2,200,000 cubic yards.

This amount of concrete would build a solid wall 20 ft. high, 6 ft. wide and 100 miles long.

The lock gates will be of the single-leaf type, extending clear across the chamber, instead of double gates meeting at the centre, as on the present Canal. The lower gates will be 82 ft. high, 88 ft. long and 10 ft. thick, built of structural steel, and weighing 1,150 tons. The upper gates, which will rest on top of the "breast wall," will be 37 ft. high, 88 ft. long, and 10 ft. thick.

The time required to pass a vessel through one of the Ship Canal locks will be about 20 minutes. The actual raising or lowering of the vessel in the lock will require but eight minutes.

The estimated time of passing a loaded freight vessel through the entire Canal, from Lake to Lake, is eight hours, as against 15 to 18 hours on the Present Canal.

When traffic is heavy, or becomes congested for any reason, several vessels of Present Canal size can be passed through the Ship Canal locks at one lockage.

The estimated cost of the Canal is $50,000,000.

Previous Welland Canals

For almost a century vessel navigation, by means of the Welland Canal, has existed between Lake Erie and Lake Ontario. During that time, however, the rapid development of trade and great increase in the size of vessels navigating the Lakes have been such that the Canal has several times had to be enlarged or rebuilt.

The first Canal, built by a private Company incorporated for that purpose, was completed in 1829, with 40 wooden locks, each 110 ft. long, 22 ft. wide, with 8 ft. depth of water. This Canal was taken over by the Government of Upper Canada, and rebuilt and enlarged on practically the same location in 1845; the locks, however, were built of masonry, and the number reduced from 40 to 27, their dimensions being 150 ft. long, 26½ ft. wide, with 9 ft. depth of water. Almost immediately after its completion the depth was increased to 10 ft. by raising the banks along the Canal reaches and increasing the height of the lock walls.

This Canal was in operation for about 30 years, when the requirements of navigation called for further enlargement, and work was commenced on the construction of the Present Canal by the Government of the Dominion of Canada, with masonry locks 270 ft. long, 45 ft. wide, and 12 ft. depth of water. The Canal was completed in 1882, and the depth of water increased to 14 ft. by the same method which had been employed on the old Canal, namely, that of raising the banks and lock walls.

The Present Canal was built on an entirely new location from the Lake Ontario entrance at Port Dalhousie South to the Village of Allanburg—about one-half the distance between Lakes—within which all the locks occur—in order to effect a straightening of the channel over the tortuous course followed by the Old Canal.

From the foregoing, it will be seen that the history of the Welland Canal has been one of almost constant enlargement and reconstruction, and so rapid has been the development of shipping on the Lakes that at no time during its existence has the Canal been of a capacity sufficient to accommodate the larger vessels sailing the Lakes. The time has now come when the demands of navigation require greater accommodation than that afforded by the Present Canal, and to meet this demand the Dominion Government has entered upon the construction of the Welland Ship Canal, which is being built of a size, this time, ample for the largest vessel sailing the Lakes today, and the largest which can reasonably be expected at any time in the future.

Welland Ship Canal

The Welland Ship Canal is being built on a new location from Lake Ontario to Allanburg, a distance of 12 miles; and from Allanburg to Lake Erie the course of the Present Canal is, more or less, followed.

Whereas all the previous Canals have had their Lake Ontario entrance at Port Dalhousie, the entrance to the Ship Canal is located at Port Weller, three miles east of Port Dalhousie, where a new harbour of most commodious proportions is being constructed.

From Lake Ontario, the Canal follows the course of the Ten-Mile Creek, crossing the present Canal twice, until Allanburg is reached. Here the Present Canal is entered, and utilized as far as Port Robinson, a distance of about three miles, this stretch being known as the "Deep Cut." At Port Robinson the Canal enters the Welland River, which will be raised 6 ft., to Canal level, by means of a dam and regulating weir at Port Robinson. This raising of the River will flood about 1,600 acres of low land between Port Robinson and the head of the River, west of Wellandport. From Port Robinson, the Canal will follow the Welland River to the Town of Welland. At Welland, the Present Canal is again entered, and followed through to Port Colborne, on Lake Erie, with the exception of about 1½ miles, at a point known as Ramey's Bend, just this side of Port Colborne, where a very pronounced "S" curve occurs in the existing Canal. Here the Ship Canal takes a straight course through a heavy rock cutting, resulting in some saving in distance and contributing toward greater ease of navigation.

It is proposed to maintain the long level between Thorold and Port Colborne at elevation 568, which is extreme low water level in Lake Erie; consequently, vessels, except during periods of extreme low water, will have to lock up from the long level a few feet into Lake Erie at the Guard Lock which is to be built in the rock cutting at Ramey's Bend, just north of the Village of Humberstone.

The Present Lake Erie entrance at Port Colborne will be utilized for the Ship Canal. The harbour will not require to be deepened at present, as it already has a depth of 22 ft.; but the present breakwater will be extended about 2,000 ft. out into the Lake in order to deaden the swells which now cause some disturbance, at times, to vessels lying at the Elevator Docks.

Where the Ship Canal follows the course of the Present Canal, the latter will be deepened, and widened on the west side, to the enlarged dimensions.

The Welland Ship Canal Construction Railway, which commences at the shore line of Lake Ontario and extends along the west side of the Canal to the Rock Crushing Plant, north of the Town of Thorold, a distance of nearly 8 miles, and which is double-tracked throughout its length, and equipped with 60-lb. rails, complete interlocking and block signal system, and telephone train dispatching system, was built and is maintained by the Department of Railways and Canals for the use of the Contractors in hauling excavated material from Sections Nos. 1, 2 and 3 to the harbour embankments in Lake Ontario, and for hauling stone, excavated from the site of the flight of locks at Thorold to the site of Locks Nos. 1, 2 and 3. The Railway is well ballasted with stone and kept in such condition that no accidents of any consequence have occurred since it has been in operation, although it is probably the busiest piece of railway in Canada.

There will be 22 bridges crossing the Canal to carry existing highways and railways, as well as several bridges over pondages, one swing bridge carrying the Constuction Railway over the Present Canal, and a temporary bridge for the Grand Trunk Railway over the foot of Twin Locks No. 4.

A few of these will be swing bridges, where the conditions favor this type, but the majority will be bascule lift bridges, or bridges of what are commonly known as the " Jack-knife " type.

For construction purposes, the Canal route has been divided into nine Sections, Section 1 being at the Lake Ontario end, and the others following consecutively through to Lake Erie. Of these nine Sections, four are under contract at the present time, namely, Sections Nos. 1, 2, 3 and 5. Sections 1, 2 and 3 include all the locks, and the value of the work which they represent is practically equal to one-half of the estimated cost of the entire Canal.

Lock No. 1 is situated at the Lake Ontario entrance just inside the shore line, Lock No. 2 one and one-half miles south, Lock No. 3 two and one-half miles south of Lock 2, and at the point where the Ship Canal will cross the Present Canal. Locks Nos. 4, 5 and 6 are double locks rising immediately one above the other, and these, with single Lock No. 7, a little further on, will raise and lower vessels 186 ft. over the escarpment at this point.

SECTION NO. 1 is under contract to The Dominion Dredging Company, Ltd., of Ottawa. This Section is about three miles long, covering 1½ miles of work in Lake Ontario, and an equal amount inland. The work consists principally of the construction of the new harbour at Port Weller; the building of Lock No. 1, with its weirs and entrance walls, the substructure of two bridges and Canal excavation.

The new harbour is being formed by the construction of two long embankments extending 1½ miles into the Lake. These are

being formed with material excavated from the Sections of the Canal between Port Weller and Thorold. The material is loaded on dump cars by steam shovels and drag-line excavators, and hauled over the Construction Railway to the Lake, where a pile and timber trestle extending out into the Lake, one under either embankment, was built to allow the trains to start the fills. As the trestles were gradually buried beneath the dumped material the tracks were shifted sideways and the embankments gradually widened to their present dimensions. The West embankment having reached its outer extremity, the trestle has been completely filled in, but the outer end of the one under the East embankment is still visible.

To overcome the difficulty which would be encountered in building a stable trestle in the deep water, the material excavated by the dredges in deepening the harbour was dumped to form an underwater embankment on the lines of the proposed trestles, and it was found possible to build these underwater embankments up to within eight feet of the surface of the Lake. The piles for the trestles were driven through this material, and a short distance into the original bottom of the Lake, thus obtaining great stability.

It is estimated that, upon completion, these harbour embankments will contain approximately 8,000,000 cubic yards of material, of which about 5,000,000 cubic yards are now in place. The balance will be used in widening out the embankments towards the outer end.

The reason for the unusual length and width to which the embankments are being built is that it was necessary to go out 1½ miles to obtain the required depth of water, and, further, this method of forming the harbour affords a very convenient and desirable means of disposing of the great mass of excavated material from the Canal between the Lake and Thorold—much preferable to the customary method employed heretofore of piling the material in unsightly spoil banks along the Canal. At the same time, these embankments will form a large area of valuable ground which can be utilized in the future for Canal and other purposes.

At the outer end of the embankments, piers 700 ft. long will be built, leaving a 400-ft. entrance for vessels between them. The entrance piers are being built by sinking reinforced concrete cribs, which will be filled with excavated material from the harbour, and a concrete superstructure built on top. Some 13 of these cribs have already been sunk in the harbour, but owing to the high water this season very little of them can be seen. About 35 cribs have yet to be built and placed in position.

The construction of the cribs is being carried on in the harbour at Port Dalhousie, 3 miles to the West, where they can be readily seen.

The basin inside the entrance piers will have a width of 1,000 ft. for a length of one mile, forming a very commodious harbour. The sides of this basin will be formed of the earth slopes of the

embankments, protected at the water line by rip-rap, and no attempt will be made to form dockage in this basin, as it is not required at the present time; and this whole stretch will be left open for such development as may be required in the future.

Along the West side of the inner harbour, however, a long pier, of crib construction similar to the outer entrance piers, will be built for the dockage of vessels; and on the East side a slip will be provided for the repairing and launching of lock gates.

The dredges at work in the harbour are excavating the channel to the required 25 ft. depth, the excavated material helping to form the embankments, as already explained.

The sand required for concrete on the Canal is obtained by dredging at the Mouth of the Niagara River. It is loaded into scows and brought to Port Weller, where it is unloaded into large bins at the sand plant located half-way out on the West embankment. The Contractors for the different Sections send their cars to this plant, where they are loaded with sand from the bins and hauled back to the various works along the Canal. A large storage pile of sand is also being formed on the West embankment.

LOCK NO. 1. At the head of this lock a heavy concrete wall at right angles to the lock walls will be seen, and from the top of this a good view of the lock construction can be obtained. This wall is known as the "breast wall," and marks the difference in height between the upper and lower level. The upper gate of the Lock, which will consist of a single leaf of structural steel, 37 ft. high by 90 ft. long, will be suspended from the East lock wall, not yet built at this point. The heel of the gate will rest on a pivot which will set in the square recess to be seen on the East side of the breast wall, and when closed the gate will rest against a timber sill which will be placed in the angle along the upstream side of the breast wall, near the top. There will be 30 ft. of water on top of the breast wall.

The walls to be seen on the opposite side of the Electric Railway tracks are the upper entrance walls to the lock. A vessel coming toward Lake Ontario passes between these entrance walls, over the top of the breast wall (after the gate has been opened), and into the Lock chamber, which has been filled with water to receive her (or may already have been full, if the last vessel through the lock was upbound). The upper gate is then closed and the water run out of the lock through valves at the lower end, until the vessel has been lowered 46½ ft. to the level of Lake Ontario, when the lower gate is opened, and the vessel passes out to the Lake.

By this, it will be seen that the Lock, when full, will contain 76½ ft. of water, namely, 46½ ft. which must be run off when lowering the vessel, and 30 ft., which is the normal depth of water in the

lock. It will also be seen that, while the head gate, resting as it will on top of the breast wall, will require to be only a little over 35 ft. in height, the lower gate of the lock must be built the full height of the side walls, or 82 ft. On the Present Canal the head gates are located immediately in front of the breast wall, and are consequently of the same height as the lower gates. By placing the head gate on top of the breast wall, the risk of accident to the gate by a boat in the lock is materially lessened, as, should an upbound vessel entering the lock get beyond control, or a mistake in signals be made, instead of running into the gate and seriously damaging it, the vessel would run against the breast wall, and the only damage caused would be that which might be sustained by the vessel itself.

A large pondage is being formed above the lock, on the East side of the Canal, extending over to the embankment which may be seen South of the road, from which water to fill the lock will be drawn, the flow being controlled by means of valves in the East wall. Large filling culverts extend through both the side walls of the lock, and at right angles to these are small lateral culverts which will empty the water directly into the lock chamber. When the valves are opened water, under pressure, will pass down a shaft to the culvert in the East wall, and also through a tunnel under the floor of the lock to the culvert in the West wall. The water will flow through these main culverts and discharge into the lock chamber through the small openings which can be seen along the base of the side walls.

The construction of the main tunnel can be seen in the East wall of Lock No. 1, and a similar tunnel exists in the West wall, but this cannot be seen, as it is now closed in. Entrance can be had to it through any of the lateral openings or through the exhaust opening near the foot of the lock.

The locks will be emptied by means of valves near the lower end of the main culvert, which, when open, will allow water to pass back through the laterals, down the main culvert to the exhaust opening, and out into the reach below.

The smaller culverts, which are being built toward the top of the West wall, are: mooring chamber for the tying up of vessels; drainage culvert, and conduit gallery for electric wiring, etc.

The work in progress to the East of the lock is in connection with the weirs or spillways which will maintain the water in the pondage above at a uniform level, all surplus water passing over the weirs into the canal below.

The long concrete wall below the lock, on the West side, is the lower entrance wall to the lock, and is of reinforced concrete construction of the buttress type, with counterforts every 12 ft. This wall is 41 ft. 6 ins. in height, and founded on rock. On the East side of the Canal, opposite this wall, the bank will be left with the

natural earth slopes for the present to allow for future development.

Lock No. 1 is founded directly on the rock, which was found at the required depth. The floor of the lock will be built of concrete, and will have the form of an inverted arch. It will be securely bolted to the rock below by means of heavy steel bolts, 14 ft. long, sunk about 10 ft. into the rock, with the upper end bent over and built into the concrete of the floor slab. The reason for this is to prevent any undue upward pressure of water from breaking the bond between the floor and the underlying rock, and cracking the concrete so as to allow leakage into the lock chamber.

The dry excavation on this Section has been completed, with the exception of some material which is being reserved for backfilling behind the lock walls.

The Electric Railway now on the trestle over the Canal work here, also the Lake road, will be carried, later, on a bascule lift bridge over the head of the lock on the old road line. This is known as Bridge No. 1, and work on the substructure is now in progress.

Bridge No. 2 is located about one mile further South, and will also be of the bascule type. This bridge will carry Con. II highway over the Canal. The substructure for this bridge has been completed.

SECTION NO. 2 is about 4½ miles long, and is under contract to Messrs. Baldry, Yerburgh & Hutchinson, of Westminster, England, and St. Catharines, Ont.

The work consists of the construction of Locks 2 and 3, with entrance walls, weirs, etc., the substructures for Bridges Nos. 3, 4 and 5, Canal excavation and building of embankments; and other miscellaneous works.

A number of steam shovels and drag-line excavating machines are employed on this Section excavating the large quantity of material to be removed; also some grading machines drawn by traction engines, which are excavating material used in the formation of the Canal embankments.

LOCK NO. 2. This lock is located North of Carleton street, and is practically a duplicate of Lock No. 1; therefore, what has been said regarding the construction of Lock No. 1 can be equally applied to this lock. The only difference is in the foundation. Owing to the fact that the rock here is about 18 ft. below the required depth, it has been necessary to carry the side walls and breast wall down that depth below the bottom of the lock.

The construction of the upper entrance walls has been almost completed, and work is proceeding on the West entrance wall below the lock.

A bascule lift bridge will be located at the head of this lock to carry Carleton street over the canal.

A pondage of about 200 acres will be located above the lock, from which water to fill the lock will be drawn. The construction of the embankments to form this pondage is being carried on by means of grading machines working the Canal Prism. These machines plough up a furrow, which is carried by a belt-conveyor and dumped into wagons drawn by mule teams driving alongside. The material is then hauled to the embankments and dumped in layers of about 8 ins. in thickness, which are well watered, and the material gradually compacted by the teams and wagons driving over it, in this way forming a thoroughly watertight bank. The East embankment of the pondage can be seen extending well around to the East side of the Canal, and on the West side the Canal itself will retain the waters of the pond.

At the Village of Homer the Canal passes through a very deep cutting, 65 ft. in depth, where a large amount of excavation has been necessary.

A very good idea of the appearance of the finished Canal can be obtained here from the temporary trestle carrying the Queenston road over the Canal. A continuous 10-ft. concrete slab will be noticed along the sides of the Canal. This is for the purpose of protecting the banks from the wearing action of the waves caused by passing vessels. The water level in the Canal will be along the centre of this concrete protection, that is, the slab will extend 5 ft. above and 5 ft. below the water line. This protection will extend along both sides of the entire Canal.

The Queenston road here will eventually cross the Canal on a double leaf bascule bridge, the piers and abutments for which are now under construction.

About one mile South of Homer, the Ship Canal will cross the Present Canal, and from this point to Lake Ontario both Canals will be available for navigation, as the waters of the two are at the same level.

LOCK NO. 3 is located here immediately adjoining the Present Canal, on the North side. The only work done at the site of this lock has been on the construction of the breast wall, which has been carried to rock foundation, and part of which has now been exposed by the excavation.

A pondage area of 150 acres is being formed on the East side of the lock, the embankments for which may be seen in course of construction.

Piers have also been built for a swing bridge on the East side of the lock to carry the Homer road, which parallels the Canal, over the channel connecting the pondage with the Canal.

SECTION NO. 3. This Section is about two miles long, principally within the Town of Thorold, and is under contract to Messrs. O'Brien & Docherty and Quinlan & Robertson of Montreal.

It is the most important and costliest Section of the Canal, as the work involves the construction of Twin Locks Nos. 4, 5 and 6 in flight; single Lock No. 7; masonry for guard gates, entrance walls, etc.; the excavation of 2,700,000 cubic yards of earth and 3,400,000 cubic yards of rock; the building of a high earth dam, with concrete core wall, for pondage at the head of Locks No. 6; two important railway diversions, and the crushing and supplying of approximately 1,200,000 tons of stone for concrete to Sections 1 and 2.

The Railway diversions consist of a relocation of a portion of the Welland Division of the Grand Trunk Railway, and a temporary diversion of the Main Line of the same Railway at the foot of Locks No. 4.

The Welland Division (Port Colborne to Port Dalhousie) traversed the site of the proposed flight locks through the Town of Thorold, and it was therefore necessary to divert this Line, for some distance, to the West side of the Canal. This diversion involved some very heavy work, as may be seen by the earth and rock cuttings throuh which the Railway passes in the Town of Thorold.

The double-track Main Line of the Grand Trunk Railway (Toronto to Niagara Falls) crosses the Canal at the foot of the proposed Twin Locks No. 4. In order that the excavation of the Canal might be carried on beneath the Railway, it was necessary to divert the Line about 50 ft. to the North and provide a temporary bridge to carry the Railway over the Canal during construction. The centre pier for this bridge was sunk through earth and rock, a depth of 90 ft., to the bottom of Lock No. 4, and will eventually be incorporated in the centre wall of the locks. When Lock No. 4 walls are completed, bascule lift bridges will be built upon them, at the foot of the lock, on the old location of the Grand Trunk, and the Railway moved back to its original location. The present bridge, which consists of four single-track spans, will be removed on scows and offered for sale.

A number of steam shovels are engaged on this Section excavating the great mass of rock to be removed preliminary to the construction of the locks. The method of excavation employed is to first drill blast holes in the rock at intervals of 18 ft., parallel with the centre line of the Canal and some distance at right angles to the centre line, and from 20 to 40 ft. in depth, after which the holes are heavily charged with dynamite and a number of them fired simultaneously, blowing up a large quantity of rock ready for the steam shovels. Well-drilling machines, operated by electricity, are used in making the blast-holes, and a number of these may be seen in operation.

The machines, having upright boilers, working along the sides of the rock, are known as "channelling" machines, and their purpose is to make a narrow cut through the rock along the sides, so that when the rock is blasted a smooth, vertical face will be left, such as now appears in the finished excavation. The concrete walls of the locks will be built against these vertical rock faces, and it is not desired that the rock outside of the lines to be excavated should be disturbed any more than can possibly be avoided, and channeling is the method adopted for achieving this result.

A fair idea may be formed of the location of each pair of locks in the flight from the present progress of rock excavation, as the dividing line between the locks is now quite marked. The first of the flight, Locks No. 4, are located with their lower ends immediately adjoining the Grand Trunk Main Line Railway. A large amount of excavation has still to be done here. From Lock 4 a vessel will be raised 46½ ft. directly into Lock 5. On the site of Lock 5 the excavation is now approaching completion. From Lock 5 another lift of 46½ ft. will take the vessel into Lock 6, where excavation is now complete to grade. Lock 6, with another lift of 46½ ft., will take the vessel into Hunt's Hollow (between the high entrance walls already built), through the Hollow, and past the old Grand Trunk Station, now removed. Lock 7 area has been utilized as a quarry for the excavation of "plums" for concrete on Sections 1 and 2. These "plums" consist of large pieces of rock from the excavation, of varying size, which are embedded in the concrete, as the walls are built up, to help form part of the mass in the heavy concrete walls.

After rising another 46½ ft. in Lock No. 7 (the head of which will be immediately opposite Lock No. 24 on the Present Canal, at Peter street, Thorold), the vessel will pass into a basin between Lock No. 7 and the Guard Gates. This basin is now being formed by building a concrete wall along the East side, which may be seen partly completed, and will also have a wall on the West side. The basin will extend to the new swing bridge which carries the N. S. & T. Ry. over the Ship Canal, and at this point two pairs of guard gates will be built, one on either side of the centre pier of the bridge. These guard gates are for safety purposes only, as the water on each side of them will be at the same level.

The Canal operations will be carried on so that there will always be two gates against the long level, that is to say, the guard gates will only be opened when both the upper and the lower gates of Lock No. 7 are closed, and neither of the Lock No. 7 gates will be opened until the guard gates are closed.

Passing through the guard gates, the vessel will enter the long level extending to Lake Erie. As this level will be kept at extreme low water elevation of Lake Erie, and as the Lake will generally be above this low water stage, it will be necessary to lock up into Lake Erie at the guard lock to be built just North of Humberstone,

as previously explained. The guard gates and the Canal banks between Thorold and Port Colborne will be built at such an elevation that should an accident happen to the guard lock at Humberstone, permitting the waters of Lake Erie to flow freely through the Canal, even at the highest known stage of the Lake no damage would occur, and the water would not be able to find its way over the escarpment.

The reason for the construction of Locks 4, 5 and 6 as twin locks is that, owing to the fact of these locks rising one immediately above the other, it would be necessary—were the locks built singly—for an upbound vessel on reaching the foot of Locks No. 4 to wait while another vessel, downbound, which might have entered Lock 6, had passed through the entire three locks; whereas with the double locks, upgoing vessels can proceed through the locks on one side while downgoing vessels are passing through on the other side, thus causing no delay to navigation.

At the head of Locks No. 6 a regulating pondage of 84 acres is being formed, from which to draw the supply of water for the flight locks. The dam which will retain the waters of this pondage will be 3,300 ft. long and 75 ft. in height at its highest point. Owing to the high head of water which will be exerted against this dam, its construction has had to be carried on in a very careful and thorough manner. The dam is of earth construction, but is built over a concrete core wall founded on the rock, the top of the core wall being at an elevation about 30 ft. below the top of the dam. The material of which the dam is built is selected earth from the Canal excavation on this Section, which was dumped along each side of the dam and rehandled into the dam by the large drag-line excavating machines which may be seen on the dam. The material is spread in layers and thoroughly watered and rolled, in order to form a perfectly watertight structure. At present, the dam is being built from the head of Locks 6 only to the West bank of the Present Canal, but it will eventually—after the operation of the Ship Canal has been fully tested—be extended across the Present Canal to the high ground on the other side.

All of the good rock excavated on this Section is used in the making of concrete, and as there is practically no rock on Sections 1 and 2, the contract for Section 3 provides that the Contractor shall erect a rock-crushing plant and crush and supply all the stone required for concrete on Sections 1 and 2. This crushing plant is located at the lower end of the Section. The Contractors for Sections 1 and 2 send their cars to this plant, where they are loaded with stone by the Contractors for Section 3, and returned to the work where required.

A good deal of the rock, as excavated, contains considerable shale and dirt, which would detract from the strength of concrete if it were allowed to remain in the stone, and as it was found impossible to so adjust the crushing plant as to properly eliminate

this, a washing plant has been erected by the Department immediately adjoining and connected with the crusher for the purpose of washing the stone. The washing plant is so arranged that stone, after passing through the crusher, can be carried on a belt conveyor to the washers, and, after washing, is dumped into bins ready for loading into cars. All of the rock which will be excavated from Lock No. 7 and from the Canal Prism above the guard gates is of a very fine quality of gray limestone, and will not require washing.

The rock which is not of a quality suitable for concrete is being used to fill in some hollows on the East side of the Canal opposite the locks, and some of it will be used as rip-rap protection to embankments.

All of the stone in the present stock pile adjoining the crusher will be washed before it is used, as well as all stone from the excavation in future which may require it.

There will be approximately 1,200,000 cubic yards of concrete in the locks and other structures on this Section. The only concrete work which has been done to date, however, is in the construction of the upper entrance walls to Lock 6 and a portion of the upper East entrance wall to Lock No. 7.

The Contractors for Section No. 3 are bringing in gravel from Lake Erie for concrete, as it is not anticipated there will be sufficient good rock from the excavation for the large amount of concrete to be placed on this Section, after Sections 1 and 2 have been supplied. A large unloading plant has been erected on the Present Canal bank, near the Transformer House, where this gravel is being unloaded, and from there hauled to storage piles on the work.

SECTION NO. 5, which is the only remaining Section under contract, covers the work of widening and deepening the Present Canal, between Allanburg and Port Robinson (about 2½ miles), through what is known as the "Deep Cut."

This Section is under contract to the Canadian Dredging Company, Ltd., of Midland, Ont.

The material excavated is being used to fill in low-lying lands on the West side of the Canal, opposite Section No. 4.

The work of widening the Canal to the new dimensions has been carried on by a number of steam shovels working on the West bank; and four powerful dredges are at work deepening the channel to the required 25 ft. depth.

The method of disposing of the excavated material has been to build embankments on the low lands adjoining the Canal, with the dry material excavated by the steam shovels, to form pondages, and these pondages are filled with material excavated by the dredges. The dredged material from the channel is loaded into scows, hauled to a basin cut in the Canal bank, and dumped in front of a 20 in. hydraulic dredge, which pumps the material into the

pondages referred to. This method will reclaim and render valuable a considerable area of otherwise worthless land.

Bridge No. 13, a highway bridge at Port Robinson, is also located on this Section. The bridge will be of the bascule lift type, and work on the substructure is now in progress.

As the Municipalities of Welland, Thorold, Merritton and St. Catharines at present draw their water supply from the Present Canal, the turning of the Welland River into the Canal at Welland will pollute the water for domestic purposes, and it is proposed to construct a pipe-line from Lake Erie to the reservoirs of the several Municipalities, through which a continuous supply of clean water will be pumped.